

VIA ECFS

May 27, 2021

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
45 L St., NE
Washington, DC 20554

Re: Notice of *Ex Parte* Presentation, ET Docket No. 19-241

Dear Ms. Dortch:

On May 25, 2021, Tarik Bolat, Byron Stanley, Bryan Fox, and Louis Paquette of WaveSense, Inc. ("WaveSense") and Ryan Thompson, Tom Peters, and I, counsel for WaveSense, spoke by telephone with Ethan Lucarelli, Legal Advisor to Acting Chairwoman Rosenworcel, to discuss WaveSense's pending waiver petition for its innovative ultra-wideband ground penetrating radar ("GPR") technology.¹

During the meeting, the WaveSense representatives discussed the attached presentation, which summarizes WaveSense's GPR technology, the status of the proceeding, and WaveSense's extensive engagement with stakeholders and regulators to resolve any concerns raised in the proceeding.² The WaveSense representatives emphasized that the record reflects a negligible risk of harmful interference to incumbents, even in worst-case scenarios.³

WaveSense reaffirms its desire to work expeditiously to satisfactorily resolve any remaining concerns. Please contact me with any questions.

Respectfully submitted,

/s/ Michele C. Farquhar
Michele C. Farquhar
Counsel to WaveSense, Inc.

cc: Michael Ha
Jamison Prime
Rodney Small
Ethan Lucarelli

¹ See WaveSense Request for Waiver, ET Docket No. 19-241 (filed July 25, 2019) ("Waiver Request").

² See Attachment A.

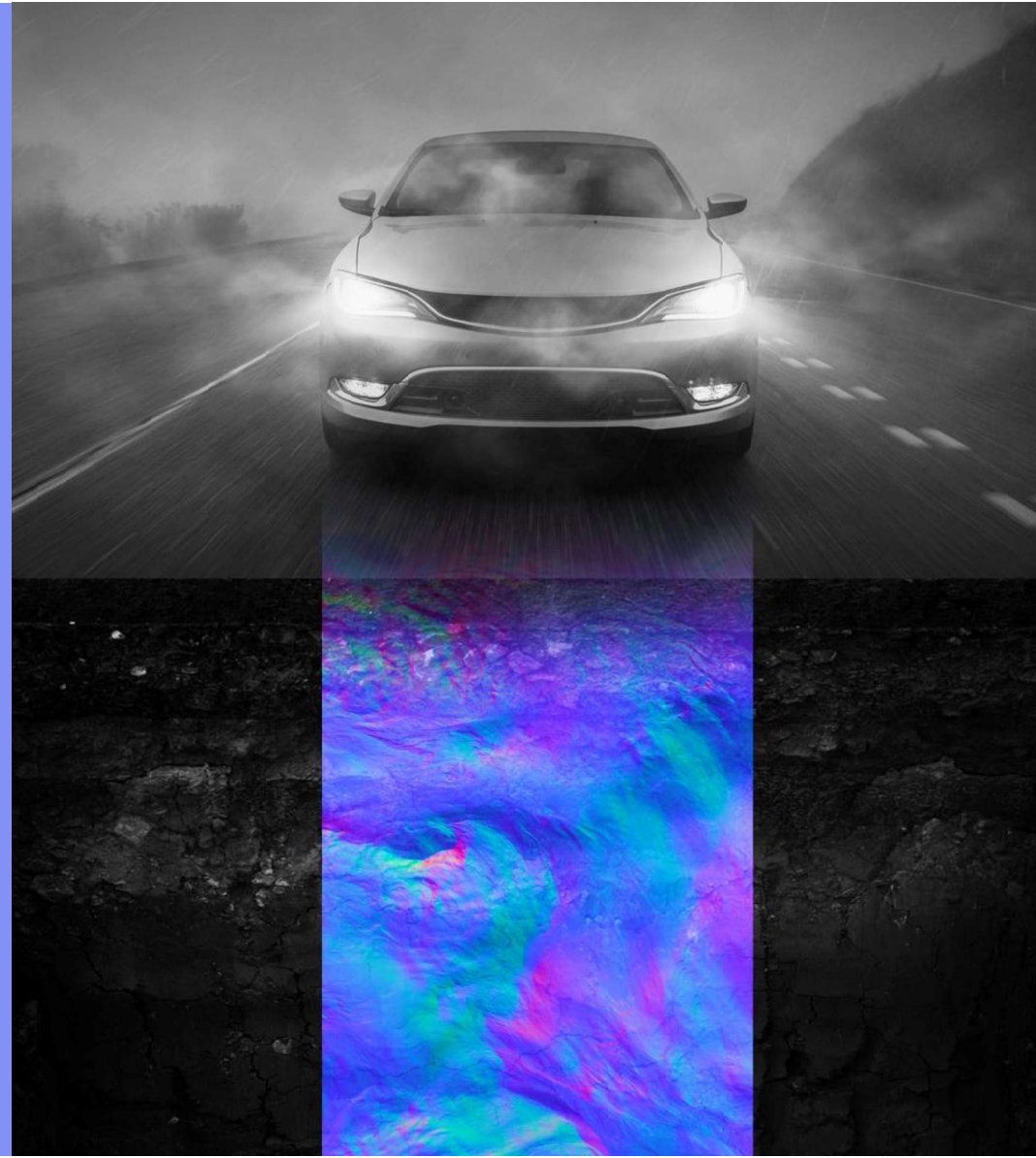
³ Waiver Request, Technical Appendix; see also Reply Comments of WaveSense, ET Docket No. 19-241, Appendix 1 (filed Oct. 1, 2019).

Attachment A



WaveSense

Prepared for the Federal Communications Commission
May 25, 2021



- WaveSense has built a unique ultrawideband (UWB) safety technology that enables autonomous vehicles to operate in a wide range of conditions. It operates in the 137 – 328.6 MHz and 335.4 – 400 MHz range.
- This technology is core to the safe deployment of next generation assisted driving systems and autonomous vehicles
- The system is specifically designed for very low emissions and safe compatibility with other users in the band
- Deployment for automotive use in the US requires UWB Part 15 unlicensed operation
- WaveSense formally meets all UWB part 15 power level requirements. The use case requires waivers for field of use and for prior coordination, which are similar to waivers granted previously.
- WaveSense's aggregate interference analysis shows that there is no interference in aviation bands; indeed, 10s of millions of automotive radars and other emitting products (microwaves, toasters, laptops, etc.) are already emitting at the 137 – 328.6 MHz and 335.4 – 400 MHz range at FCC Part 15 UWB power levels with no waivers required for operations.

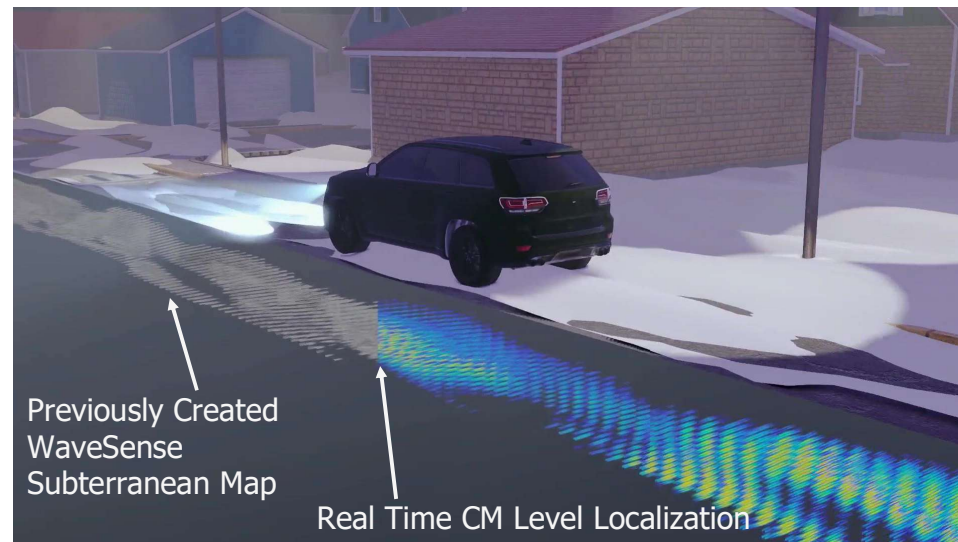
WaveSense is a comprehensive built-for-purpose positioning solution

A proprietary ground penetrating radar (GPR), map, and software solution

Step 1: Map



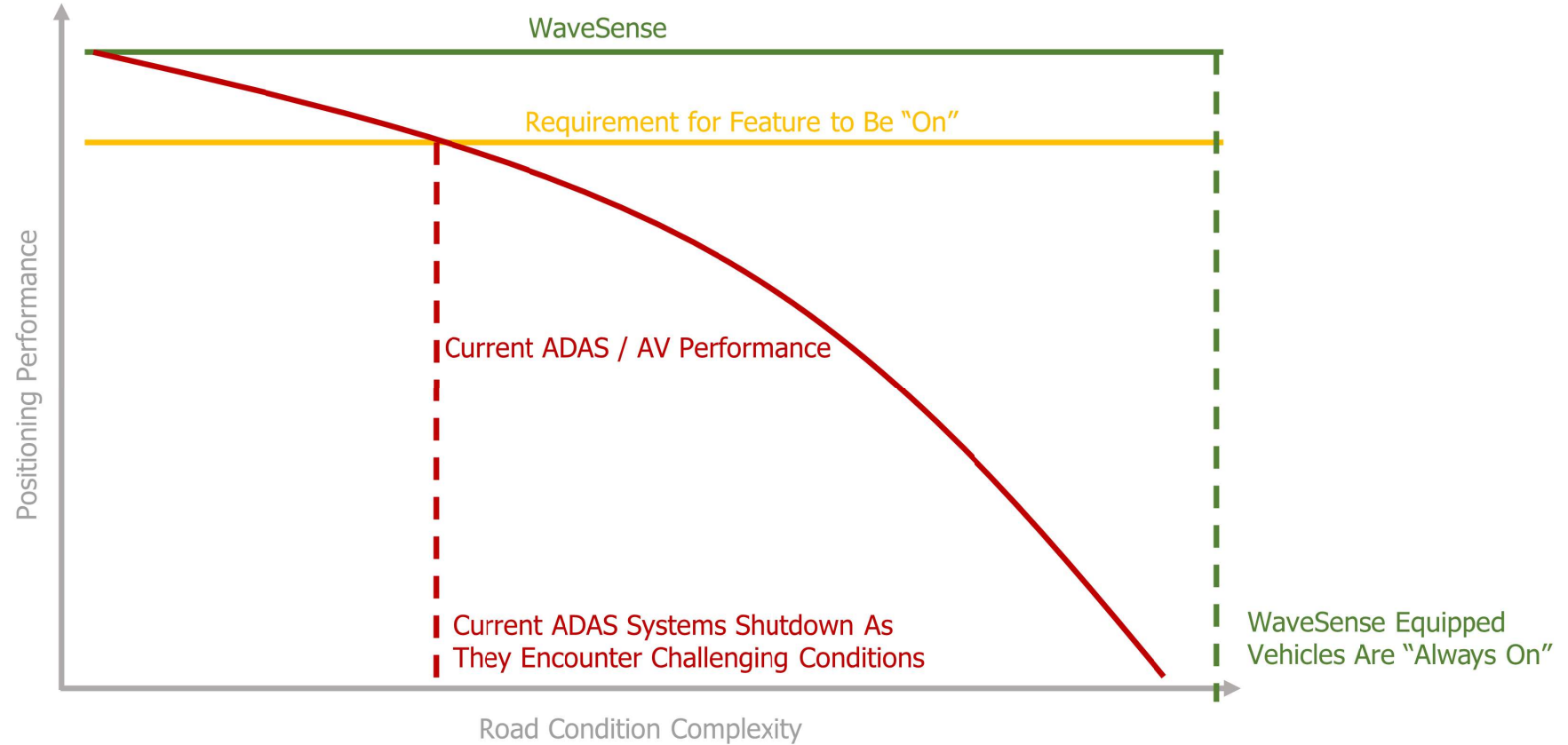
Step 2: Localize



WaveSense's mission is to prioritize transportation safety broadly

- While not a standalone safety system, WaveSense's groundbreaking technology enables new levels of performance and safety for passenger and autonomous vehicles, resulting in the reduction of traffic deaths and injuries
- Safety for us isn't confined to the road: we're focused on ensuring our product does not interfere with other key safety and communications systems
- WaveSense began meeting with key federal stakeholders in August of 2018 to understand potential concerns so that they could be proactively addressed. These included the FAA, NTIA, DoD, and DoT.
- As a result of these meetings, we've narrowed the bands we're operating in and completed analysis to understand if WaveSense would interfere with military and civilian aviation safety systems. The clear conclusion from these analyses is that any potential interference would be negligible. All analyses have been shared with the federal agencies listed above.
- WaveSense expands automotive performance and safety without compromising the safety of other modes of transport – including the excellent safety record consistently delivered in aviation

Why lidar, camera, and GPS aren't reliable for automotive deployment



- WaveSense accelerates the arrival of safety features for passenger vehicles and safe and reliable autonomous vehicles:
 - Existing sensors fail often, especially in poor weather conditions
 - Statistically independent sensor fusion enables orders of magnitude failure rate reduction
 - Enables active lanekeeping and positioning even in no visibility conditions (snow, fog, etc.)
 - Maps are stable, enabling higher safety and reliability ratings
- Improving public health and safety:
 - >37k traffic deaths and >2.4 million traffic injuries per year in the US¹ – 94% are attributable to human error while 52% of traffic fatalities are a result of lane departures²
 - 21% of crashes, 19% of injuries, and 16% of fatalities are due to weather conditions³
 - Autonomous vehicles (AVs) are expected to reduce tailpipe emissions – responsible for 53k premature deaths in the US each year⁴ - by increasing ride-sharing (reducing total cars on road) and making traffic flow more efficiently

1) NHTSA

2) US Federal Highway Administration

3) "Fatality Facts 2018: Yearly snapshot", Insurance Institute for Highway Safety (IIHS), <https://www.iihs.org/iihs/topics/t/general-statistics/fatalityfacts/overview-of-fatality-facts>

4) Caiazzo, Fabio, et al. "Air pollution and early deaths in the United States. Part I: Quantifying the impact of major sectors in 2005." Atmospheric Environment 79 (2013): 198-208.

- Positive economic impact:
 - \$242 billion of GDP lost due to traffic accidents in 2010 and \$594 billion lost due to premature death and decreased quality of life due to injuries¹
 - Further economic and welfare gains unlocked by freeing up time currently dedicated to commuting for productive work and leisure (50 minutes per day on average)²
- Enabling mobility for all Americans:
 - AVs open up mobility to those with a disability that prevents them from driving a vehicle (there are 53 million Americans with a disability) ³
 - AVs make mobility much more affordable and convenient, enabling those who currently cannot afford to own a car or pay for a taxi to enjoy safe and reliable transport (projected cost per mile of average taxi is \$3.50, of personal car ownership is \$0.70, and for an AV ride share is \$0.26) ⁴



Automakers are deciding today tomorrow's assisted driving and autonomous specifications – a delay in WaveSense's arrival on US roads is a delay for safety and welfare of Americans

1) NHTSA

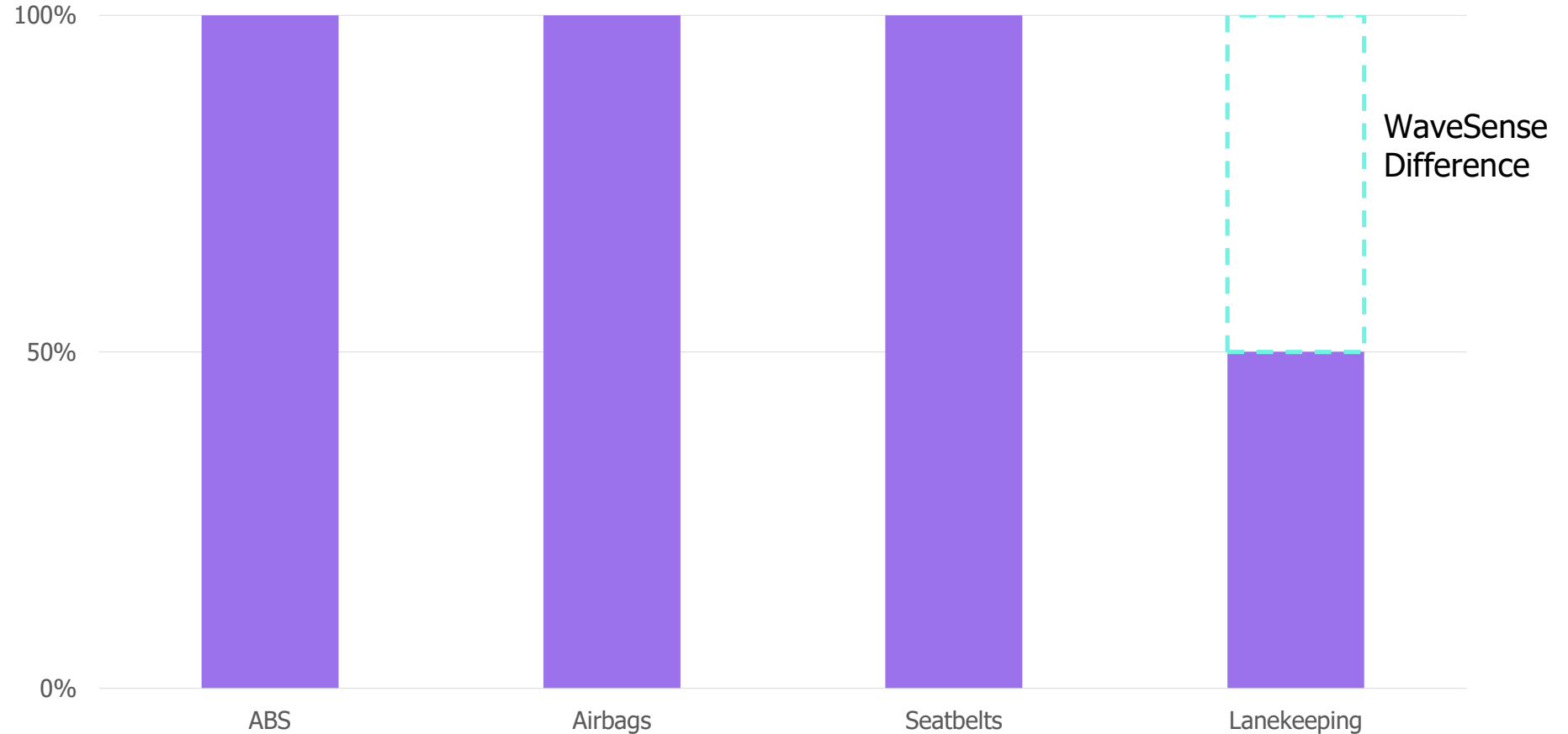
2) McKinsey & Co.

3) CDC

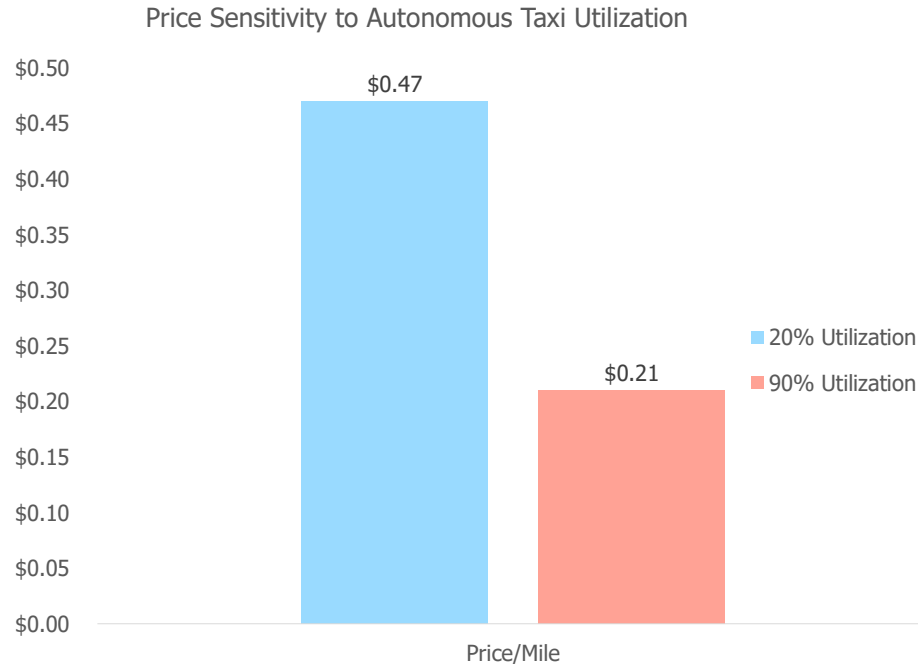
4) Ark Investment Management, an investment research firm

WaveSense drives lanekeeping to a core safety feature

Core Safety Feature Reliability



WaveSense increases utilization which drives AV affordability



Source: Ark Invest, full analysis and model at <https://ark-invest.com/research/autonomous-taxi-model>

WaveSense Drivers of Utilization

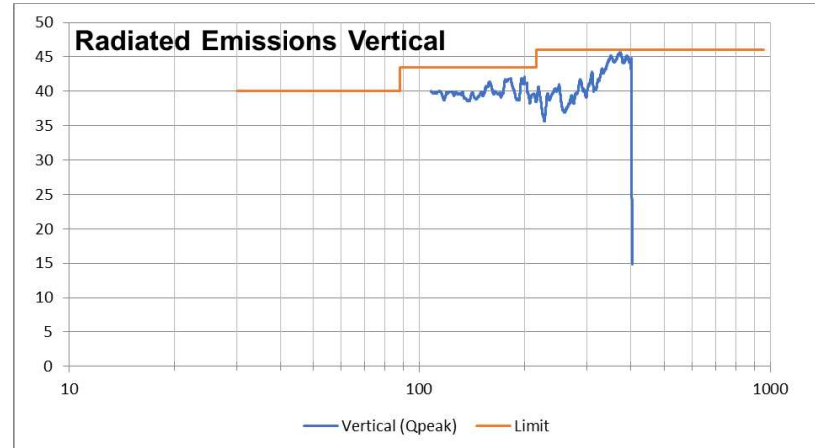
- Operations in:
 - Inclement weather
 - Low-feature environments
 - Poor lane markings
 - Surface environments with significant dynamics
- Increased safety and competence increases overall demand for rides
- Uncorrelated map reduces likelihood of common point of failure

WaveSense GPR meets 47 CFR 15.509 UWB power level regulations

- System is intentionally designed for very low emissions to ensure safety and operation of other users' functions
- 47 CFR 15.509(d): (d) The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in § 15.209

Frequency (MHz)	Field Strength @ 3m (dBμV/m)
88-216	43.5
216-960	46.0

- WaveSense GPR has been formally tested as compliant (03/19/2019, 04/16/2019, 06/22/2020)



Section	Para	Summary	Compliance	Prior Waivers
15.509	(b)	Limited field of use	Waiver	Headsight, Inc. Request for Waiver of Part 15 of the Commission's Rules Applicable to Ultra-Wide Band Devices, Order, 32 FCC Rcd 1511 (2017)
15.525		Prior coordination requirement	Waiver or Permission	Kyma Medical Technologies Ltd/Request for Waiver of Part 15 of the Commission's Rules Applicable to Ultra-Wideband Devices, Order, 31 FCC Rcd 9705 (2016)

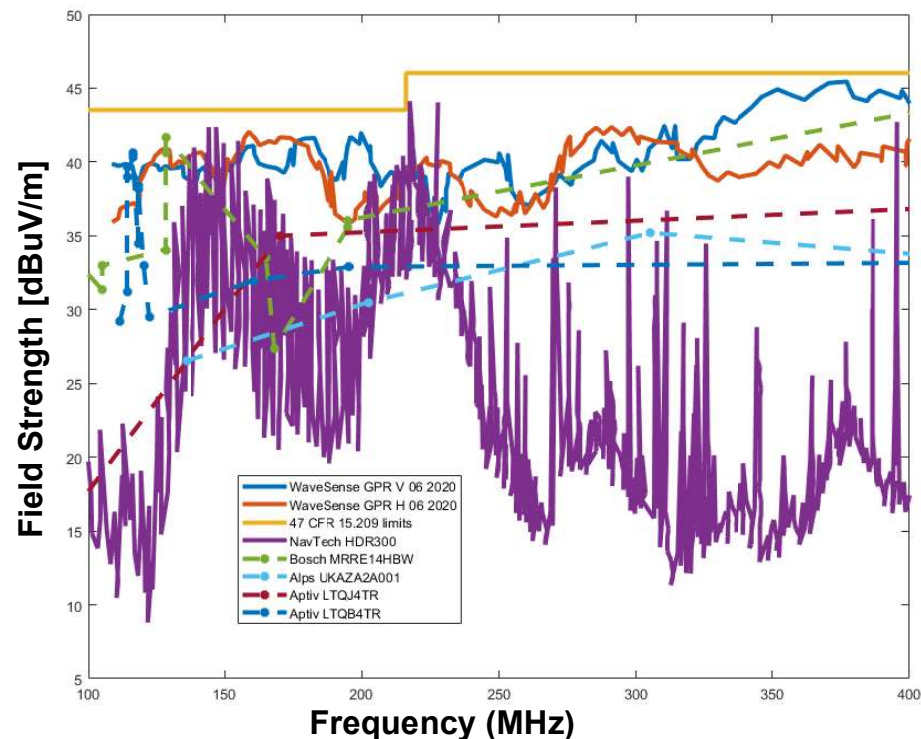
- FCC's UWB Order¹: Aggregate use case for automotive use at 15.209 levels was previously considered
 - "Vehicular Radar Systems... Consistent with our cautious approach, we are requiring that emissions below 960 MHz be at or below the § 15.209 limits"
 - "One of the largest potential outdoor uses of UWB technology is vehicular radar. However, we do not believe that the proliferation of such devices will result in increased interference concerns at the emission levels and frequency range being adopted..."
 - "Because we are requiring the lower frequency emissions to be attenuated below the Part 15 general emission limits, the interference potential from vehicular radar systems to lower frequency radio systems will be less than the interference potential of conventional Part 15 devices."

1) https://transition.fcc.gov/Bureaus/Engineering_Technology/Orders/2002/fcc02048.pdf (accessed 3/12/2020)

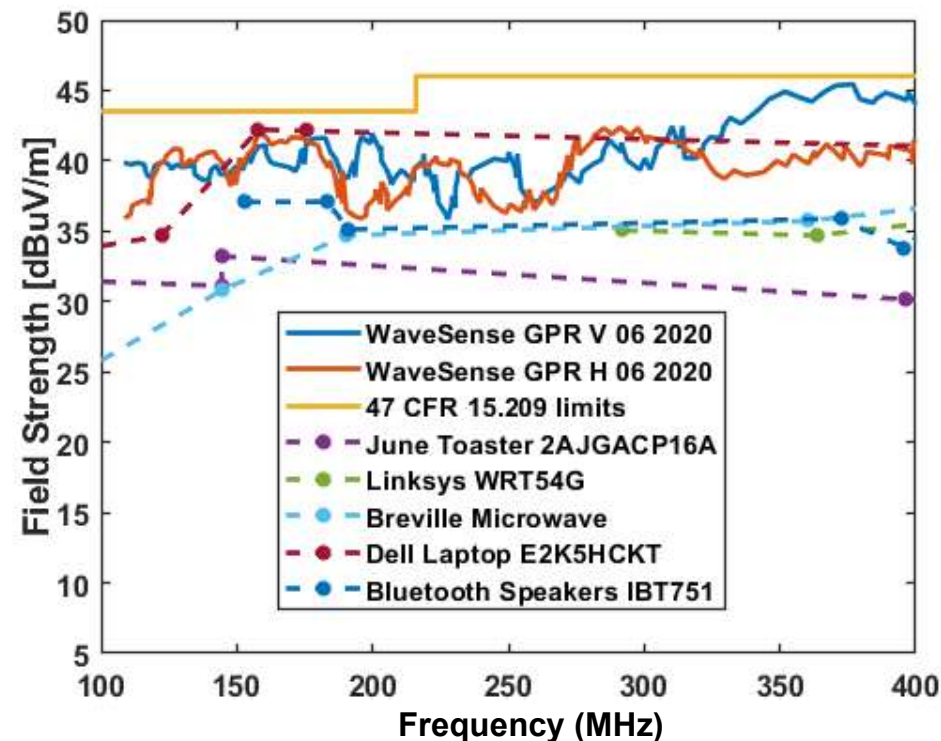
Safe compatibility in target bands has been established at scale

Forward facing automotive radars, microwaves, toasters, and other devices number in the tens of millions today and have unintended emissions of similar strength in the bands WaveSense utilizes

**Unintended Emissions for Automotive Radar (From FCC Filings)
Compared to WaveSense Emissions**



Unintended Emissions for Other High Volume Devices



- Meets 47 CFR 15.209 power levels
- Despite worst case analyses with conservative assumptions prepared for FCC, DOD, DOT, FAA and NTIA that demonstrate interference is not a concern, WaveSense has agreed to notch specific bands
- Frequency interference analysis to address FAA concerns shows WaveSense has substantial margin above standard regulatory interference standards.
- Meets same power levels and frequencies as allowed for existing unintended automotive radar emissions in 47 C.F.R. § 95.3379(a)(1) and for which emissions occur from 10s of millions of devices in circulation today

- WaveSense is a novel automotive safety technology that radically enhances safety, including in some of the most dangerous road conditions (snow, confusing/no lane markings, etc.)
- Analyses and testing have shown extreme unlikelihood of interference issues
- Providing clarity to the market now is critical given 4+ year planning cycles from automakers
- Limits such as quantity, years of use, or prior coordination would make the technology nonviable for automotive use
 - Automakers decide 4+ years before a vehicle model is manufactured to invest in inclusion of new technologies and expect vehicles to be on the road for 15+ years after sale
 - Individual users of WaveSense's GPR technology cannot reasonably coordinate with the Commission when they use their vehicles to travel
- WaveSense has worked with key federal agencies over the past 2+ years to address all potential issues